AN EXPERIMENTAL STUDY ON THE APPLICATION OF THE BOPPPS TEACHING MODEL IN PUBLIC PHYSICAL EDUCATION MARTIAL ARTS CLASSES AT UNIVERSITIES*

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Abstract

This study investigates the application of the BOPPPS teaching model in university martial arts classes, aiming to enhance students' physical fitness, technical performance, theoretical knowledge, cooperative learning, and motivation. Using a quasi-experimental design, 80 sophomore students from Guangxi University of Foreign Studies were divided into an experimental group (BOPPPS) and a control group (traditional). Data were collected through physical fitness tests, martial arts skill assessments, theory examinations, and questionnaires, and analyzed with SPSS 26.0.

Results showed that the BOPPPS model significantly improved students' lung capacity, endurance, and core strength, as well as their martial arts technical accuracy and theoretical knowledge. It also enhanced cooperative learning ability by strengthening communication, role division, and teamwork, while reducing passivity and increasing initiative in classroom participation. These findings demonstrate that BOPPPS provides a more effective and engaging framework for

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martial arts instruction than traditional methods. The study offers empirical evidence supporting the integration of BOPPPS into physical education curricula, contributing both to student-centered pedagogy and to the broader reform of higher education sports teaching in China.

Keywords: BOPPPS teaching model, martial arts education, experimental research, cooperative learning, physical fitness, student engagement

Introduction

With the implementation of the Healthy China 2030 strategy, physical education in Chinese universities is undergoing significant reform. The focus has shifted from purely technical training toward promoting students' physical fitness, skill development, cultural literacy, and lifelong exercise habits. Within this context, martial arts (Wushu) plays a unique role. It not only improves strength, speed, flexibility, and coordination, but also conveys values of etiquette, perseverance, and harmony that contribute to cultural identity and holistic education.

However, the traditional Wushu teaching model is predominantly teacher-centered, relying on demonstration and student imitation. This approach often leads to limited classroom interaction, low student engagement, and superficial understanding of martial arts culture. Assessments are mainly summative, focusing on technical accuracy while neglecting students' learning motivation, teamwork, and reflective ability. These shortcomings restrict the broader educational value of martial arts in higher education.

The BOPPPS teaching model- Bridge-in, Objectives, Pre-assessment, Participatory learning, Post-assessment, and Summary- originated in Canada and has been successfully applied in diverse disciplines. Research demonstrates its effectiveness in fostering student engagement, diagnostic learning, and real-time feedback. In China, BOPPPS has been localized and integrated into fields such as

language, medicine, and physical education, where it has shown improvements in technical skills, cooperation, and motivation.

Despite these advances, few empirical studies have systematically tested BOPPPS in the context of university-level martial arts education. Most research remains descriptive or focused on general PE courses rather than Wushu specifically. This creates a gap in evidence-based strategies for integrating BOPPPS into martial arts instruction.

Therefore, this study investigates the application of the BOPPPS teaching model in public physical education martial arts classes. It aims to examine its impact on students' physical fitness, technical performance, theoretical knowledge, cooperative learning, and motivation, while comparing outcomes with traditional teaching methods. By addressing this gap, the study seeks to provide both theoretical insights and practical guidance for improving martial arts pedagogy and advancing physical education reform in universities.

Objectives

1. To evaluate the impact of the BOPPPS teaching model on students' physical fitness indicators, including lung capacity, sprint performance, endurance, strength, and flexibility.

2. To compare students' martial arts technical performance and theoretical knowledge between the experimental (BOPPPS) and control (traditional) groups, and to verify whether BOPPPS enhances skill mastery and knowledge acquisition.

3. To examine the effect of the BOPPPS model on students' cooperative learning ability, focusing on communication, division of labor, decision-making, and conflict resolution.

4. To analyze the influence of the BOPPPS model on students' learning motivation and interest, with particular attention to reducing passivity and increasing initiative and participation.

5. To identify the strengths and limitations of applying the BOPPPS teaching model in martial arts education and to provide practical recommendations for optimizing classroom design and promoting physical education reform.

Literature Review

The BOPPPS teaching model, originating in Canada during the 1970s through the Instructional Skills Workshop (ISW), has gradually evolved into a well-recognized instructional framework across disciplines. The model structures lessons into six phases: Bridge-in, Objectives, Pre-assessment, Participatory Learning, Post-assessment, and Summary. These components form a closed-loop cycle, ensuring that learning begins with clear objectives and engagement, progresses through diagnostic checks and active participation, and concludes with reflection and feedback. Its emphasis on student-centered learning, interactive participation, and timely feedback makes it distinct from traditional lecture-based methods.

International Research on BOPPPS

International scholarship on BOPPPS highlights its versatility across disciplines and its ability to enhance higher-order thinking skills.

In medical education, Brown and Schmidt (2020) found that using BOPPPS increased diagnostic reasoning by 22% and critical thinking by 28%, largely due to the integration of pre-assessment and real-time case-based learning. Similarly, Lim et al. (2019) applied the model in nursing education, reporting improved clinical decision-making and patient-care simulations. These studies underscore the model's potential in disciplines requiring critical, evidence-based judgment.

In engineering and applied sciences, Thompson et al. (2019) demonstrated that embedding collaborative design tasks into the participatory learning phase improved both creativity and teamwork, with innovation project scores rising by 30%. The structured learning cycle of BOPPPS provided students with clear benchmarks at each stage, ensuring progressive development of problem-solving and applied technical skills.

In language and communication studies, Lee (2021) reported that oral fluency and intercultural communication increased when BOPPPS was used in communicative classrooms. Students benefited from pre-class preparation (self-assessment quizzes) and in-class participatory discussions, which together fostered greater confidence and willingness to communicate.

Overall, international findings converge on three points: (1) BOPPPS provides clear instructional scaffolding, (2) it enhances student engagement through interactive phases, and (3) it systematically integrates assessment with teaching, ensuring learning gaps are identified and addressed.

BOPPPS in Chinese Higher Education

Since its introduction around 2010, the BOPPPS model has been localized and adapted within the Chinese higher education context, aligning with the national goal of quality-oriented education .

Wu Jihong (2014) was among the first to apply BOPPPS in college English courses, proving that it significantly improved classroom interaction. Cao and Yin (2016) later conducted theoretical analyses, confirming that the six stages correspond to China's educational reform priorities of outcome-based learning, formative assessment, and active participation.

More recent studies have explored technological integration. Yang (2020) examined the "Rain Classroom + BOPPPS" model, combining online pre-class resources with interactive in-class teaching. This approach improved attendance by 25% and theory pass rates by 15%. Similarly, Pu and Zhang (2022) incorporated AI-powered learning analytics, using data-driven diagnostics to

personalize student feedback. Their findings suggest that BOPPPS is adaptable to blended and smart classroom environments, supporting China's digital transformation in education.

In physical education contexts, Li Haipeng et al. (2021) developed a "Safety Protection + Tiered Practice" framework to reduce injury risk in PE courses. Wu Luyang (2023) applied BOPPPS in junior high school gymnastics, creating a three-dimensional teaching model (acquisition + development + cultivation). Results showed that students improved flexibility and strength by 15–20%, with gymnastics scores rising by 1.14–1.22 points. These localized adaptations highlight the model's potential not only for skill mastery but also for fostering emotional and cultural literacy, which is increasingly valued in Chinese education.

Applications in Physical Education and Sports

The application of BOPPPS in sports and physical education has drawn growing interest in recent years because of its ability to connect cognitive learning, physical performance, and teamwork.

Wu (2023) demonstrated that in gymnastics classes, BOPPPS-based instruction enhanced both physical indicators (flexibility and core strength) and technical scores, largely due to its participatory learning and post-class reflection components. Gao (2019) applied the model in basketball instruction, finding that game-based introductions and team competitions improved students' technical skills by 35%, teamwork awareness by 28%, and classroom engagement by 40%. Li (2022) studied its application in badminton teaching, reporting significantly higher pass rates in technical proficiency and stronger cooperative learning outcomes.

In martial arts education, Deng (2023) provided empirical evidence that applying BOPPPS in university-level Wushu courses led to a 15% improvement in theoretical knowledge and higher motivation levels compared to traditional

methods. Importantly, Deng emphasized that the interactive and feedback-oriented nature of BOPPPS helped students overcome technical challenges more effectively than repetitive drill-based teaching.

Together, these studies confirm that BOPPPS offers a comprehensive approach to sports education, addressing not only physical fitness and technical mastery but also collaborative learning, motivation, and cultural engagement.

Comparative Analysis with Traditional Teaching Models

Although both BOPPPS and traditional models share the overarching goal of improving skills, physical fitness, and sportsmanship, their philosophies and processes differ significantly.

Philosophy: Traditional PE remains teacher-centered, relying on demonstrations and student imitation, while BOPPPS is student-centered, emphasizing active participation and immediate feedback.

Structure: Traditional methods follow a three-phase process (preparation, main teaching, conclusion), whereas BOPPPS consists of six stages that allow dynamic adjustment based on diagnostic assessments.

Feedback: Traditional teaching often delays evaluation until the end of a course, while BOPPPS integrates continuous formative and summative assessments.

Engagement: BOPPPS creates a more interactive, motivational learning atmosphere, addressing the monotony and passivity often found in traditional classrooms.

This comparison highlights why BOPPPS may be particularly valuable in martial arts education, where motivation, cultural appreciation, and collaborative skills are as important as physical technique.

Research Gap in Wushu Education

Despite the growing body of evidence, there remains a critical research gap in applying BOPPPS to university-level Wushu instruction. Most studies in China have focused on badminton, basketball, or general PE courses, with very

few systematically testing the model in martial arts classes. Traditional Wushu pedagogy often emphasizes rote imitation and technical drills, resulting in low classroom interaction, weak cultural integration, and insufficient attention to teamwork or reflective learning.

Moreover, while existing literature confirms that BOPPPS enhances skill standardization, teamwork, and motivation, it has not yet been fully tested against the dual nature of Wushu:

Physical dimension – cultivating strength, flexibility, coordination, and endurance.

Cultural dimension – embodying philosophical values such as "harmony of body and mind," ethical principles of respect and restraint, and national identity through martial traditions.

Thus, this study addresses the gap by conducting a controlled experimental design in university martial arts classes, systematically evaluating the effects of BOPPPS on physical fitness, skill mastery, theoretical knowledge, cooperative learning, and motivation. By doing so, it provides empirical evidence for integrating BOPPPS into higher education martial arts pedagogy, contributing to both theory (student-centered sports education) and practice (curriculum reform under the Healthy China 2030 strategy).

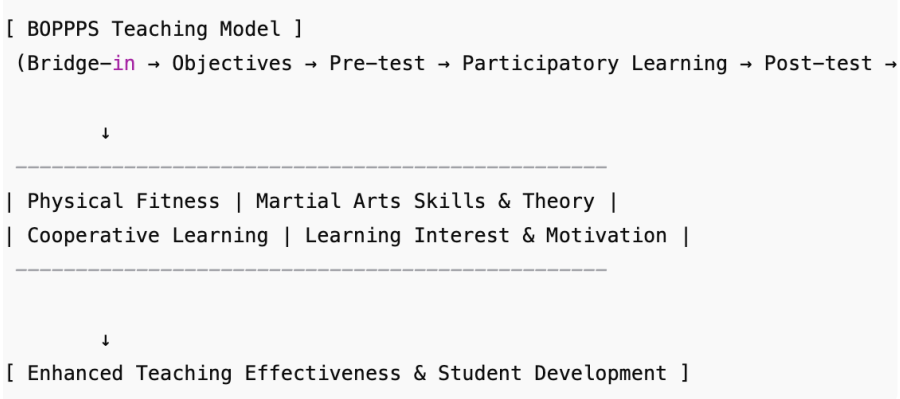

Figure 1: Conceptual model

Methodology

This study employed a quasi-experimental research design using a pre-test/post-test control group approach. The purpose was to investigate the effect of the BOPPPS teaching model in comparison with the traditional demonstration–imitation method in public physical education martial arts classes at the university level. The design allowed for controlled comparisons between two groups while ensuring baseline equivalence through pre-testing, thereby enhancing internal validity.

Participants

The study population consisted of sophomore students enrolled in the 2024 cohort of public physical education martial arts courses at Guangxi University of Foreign Studies. A sample of 80 students was selected and divided into two intact classes:

Experimental group (n = 40): received instruction under the BOPPPS teaching model.

Control group (n = 40): received instruction using the traditional teaching method.

Pre-test analysis confirmed no significant differences ($p > 0.05$) between the groups in terms of physical fitness, learning attitudes, and collaborative abilities, thereby ensuring baseline comparability.

Research Instruments

The study employed a combination of physical tests, assessments, and questionnaires to measure outcomes.

Physical Fitness Tests (based on National Student Physical Health Standards):

Height, weight, BMI

Lung capacity

50m sprint

Standing long jump

Flexibility (seated forward bend)

Male: pull-ups and 1000m run

Female: sit-ups (1 min) and 800m run

Martial Arts Skill and Theory Assessments

Skill evaluation by three expert judges based on:

Movement specification (40%)

Performance proficiency (30%)

Difficulty coefficient (30%)

Theory test covering martial arts history, technical principles, and training methods.

Questionnaires

Learning Attitude Survey (pre-test)

Collaborative Learning Ability Scale (Wang, 2002; revised version) – 20 items, 4 dimensions (communication, division of labor, decision-making, conflict resolution).

Learning Interest Questionnaire (Gu & Xie, 2019) – 27 items across 5 dimensions (passivity, initiative, skill acquisition, extracurricular activity, sports engagement).

All instruments underwent expert review for content and structural validity. KMO values exceeded 0.7 and Bartlett's test $p < 0.05$, confirming construct validity. Cronbach's $\alpha > 0.9$ for all scales, indicating high internal consistency.

Experimental Procedures

The teaching intervention lasted 12 weeks (24 teaching hours), conducted in the university martial arts hall.

Pre-test Phase (Week 1):

Physical fitness assessment

Learning attitude questionnaire

Collaborative learning pre-test

Intervention Phase (Weeks 2–11):

Experimental group: instructed using the BOPPPS teaching model, which followed six structured stages:

Bridge-in: motivational videos, cultural stories, or short demonstrations.

Objectives: clear and measurable goals shared at the beginning of each lesson.

Pre-assessment: diagnostic quizzes, teacher questioning, or short demonstrations to identify prior knowledge.

Participatory Learning: group practice, error correction, cooperative sparring, and peer evaluation.

Post-assessment: mini-tests or demonstrations to evaluate learning outcomes.

Summary: reflection activities and teacher-student discussions.

Control group: instructed using the traditional teacher-centered model, with emphasis on demonstration and student imitation.

Post-test Phase (Week 12):

Physical fitness tests

Martial arts skill assessment and theory test

Post-questionnaires on cooperative learning and learning interest

Control of Experimental Conditions

To ensure research rigor:

Both groups were taught by the same instructor, with the researcher acting as an assistant.

Identical curriculum content (e.g., Tai Chi routines such as Grasping the Sparrow's Tail) and lesson pacing were used.

Classroom space, equipment, and teaching hours were kept constant.

A single-blind design ensured students were unaware of being part of an experiment, minimizing bias.

Data Collection and Analysis

Data Collection:

Pre-test and post-test results (physical, skill, and questionnaire data) were collected manually and through Wenjuanxing.

Data Analysis:

Using SPSS 26.0, the following analyses were conducted:

Descriptive statistics (Mean ± SD)

Independent-samples t-tests to compare differences between experimental and control groups

Reliability testing (Cronbach's alpha)

Validity confirmation (KMO & Bartlett's tests)

Significance Level: $p < 0.05$ was set as the threshold for statistical significance.

Results

Objective 1: To evaluate the effect of the BOPPPS teaching model on students' physical fitness indicators (lung capacity, sprint performance, endurance running, strength, and flexibility).

After the 12-week intervention, students in the experimental group showed significant improvements in key physical fitness indicators compared to the control group. Lung capacity increased markedly ($p=0.041$), 800-meter endurance running times were faster ($p=0.032$), and female sit-up scores were higher ($p=0.014$). Although improvements in standing long jump and flexibility were observed, they did not reach statistical significance. These findings indicate that BOPPPS promotes targeted and effective development of cardiopulmonary

function and core strength by combining participatory learning with structured physical training.

Objective 2: To compare students' martial arts technical performance and theoretical knowledge between the experimental (BOPPPS) and control (traditional) groups and verify whether BOPPPS improves skill mastery and knowledge acquisition.

The experimental group achieved significantly higher martial arts technical performance scores (M=85.25) and theoretical knowledge scores (M=85.98) than the control group ($p<0.05$). The integration of pre-assessment, group error correction, and post-assessment feedback allowed students to refine technical accuracy and deepen understanding of Wushu principles. This demonstrates that BOPPPS not only improves movement standardization and coordination but also facilitates the internalization of martial arts knowledge.

Objective 3: To examine the impact of the BOPPPS model on students' cooperative learning ability, including communication, division of labor, and team decision-making.

Post-test results from the Collaborative Learning Ability Scale revealed that the experimental group scored significantly higher (M=86.48, $p<0.01$) than the control group (M=84.13). Students displayed more effective communication, clearer division of tasks, and better conflict resolution skills during group practice. This shows that BOPPPS systematically transforms teamwork from spontaneous collaboration into a trainable skill, fostering stronger peer interaction and shared responsibility.

Objective 4: To analyze the influence of BOPPPS on students' learning interest and motivation, focusing on passivity reduction, initiative, and participation rates.

The experimental group reported significantly lower passivity scores and higher enthusiasm and skill-learning motivation ($p<0.05$). Students were more engaged during class, asked more questions, and actively participated in peer

evaluation sessions. Although extracurricular activity and attention rate scores were not statistically different, an upward trend was observed, suggesting that BOPPPS helps create a positive learning atmosphere that sustains student interest.

Objective 5: To identify the strengths and limitations of applying the BOPPPS teaching model to martial arts education and propose practical recommendations for optimizing classroom design and promoting physical education reform.

The strengths of BOPPPS lie in its structured, student-centered process that integrates pre-assessment, participatory learning, and post-assessment into a coherent teaching cycle. It enhances physical fitness, skill acquisition, teamwork, and motivation more effectively than traditional teaching. However, a limitation observed in this study is that movement standardization may still benefit from supplemental repetitive drills, and time management must be carefully handled to avoid excessive classroom load. Based on these findings, it is recommended that universities integrate BOPPPS into martial arts instruction while combining its participatory elements with the precision of traditional demonstration–imitation methods to achieve balanced and efficient learning outcome.

Discussion

The results of this study provide strong evidence that the BOPPPS teaching model has a significant positive effect on physical fitness development, martial arts skill acquisition, cooperative learning ability, and learning motivation among college students. This discussion interprets the findings in light of existing literature, explores their theoretical implications, and identifies areas for improvement.

5.1 Impact on Physical Fitness The findings showed statistically significant improvements in lung capacity, 800-meter endurance running, and core strength for students in the experimental group, confirming the first research objective. These results align with Wu Luyang (2023), who reported that BOPPPS-based PE classes improve cardiovascular endurance and flexibility through targeted, progressive training. By integrating physical conditioning into participatory learning, the model avoids the monotony of traditional fitness drills and increases student engagement. The pre-test stage plays a key role by diagnosing physical weaknesses and enabling teachers to design tiered interventions that match students' capabilities. This adaptive approach supports Vygotsky's Zone of Proximal Development, where learning tasks are scaffolded to maximize potential growth.

5.2 Improvement of Martial Arts Skills and Theoretical Knowledge Students in the experimental class scored significantly higher on both technical performance and theoretical knowledge assessments. This confirms that the BOPPPS model enhances not only the precision of movement execution but also the cognitive understanding of Wushu principles. Similar results were observed by Deng Yuyan (2023), who reported that BOPPPS significantly increased martial arts skill standardization and theoretical comprehension in university Wushu courses. The model's six-step process encourages students to prepare before class, actively engage in group error correction, and consolidate knowledge during the summary phase. These mechanisms are consistent with constructivist learning theory, which posits that knowledge is actively built through learner interaction and reflection.

5.3 Enhancement of Cooperative Learning Ability The significant improvement in collaborative learning ability indicates that BOPPPS effectively transforms teamwork into a structured, trainable skill. The participatory learning phase fosters communication, role assignment, and collective problem-solving—addressing a key weakness of traditional PE instruction, which often relies on

teacher-centered demonstrations. This result supports Wang Tan's (2002) argument that well-designed collaborative tasks and clear goal-setting increase student responsibility and participation. The post-assessment and peer review mechanisms further ensure individual accountability, minimizing "free-riding" behavior and promoting equitable contribution within teams.

5.4 Stimulation of Learning Interest and Motivation The experimental class showed reduced passivity and higher enthusiasm toward martial arts classes, confirming that BOPPPS promotes intrinsic motivation. These findings align with Herzberg's Two-Factor Theory, where achievement and recognition serve as motivators. By providing clear learning objectives and immediate feedback, the BOPPPS model enhances students' sense of accomplishment and satisfaction. The use of multimedia introductions, group practice, and post-class reflection creates a more dynamic and engaging learning environment, leading to higher attendance and sustained participation—an issue frequently cited as a challenge in traditional PE courses (Zhou N., 2021).

5.5 Strengths and Limitations of BOPPPS Application The study highlights several strengths of BOPPPS: structured teaching design, active student participation, and improved teaching efficiency. However, some limitations were observed. First, despite significant gains, movement standardization in the experimental group may still benefit from repetitive technical drilling commonly used in traditional methods. Second, careful time management is essential, as the multi-phase structure can lead to increased preparation and class time requirements. Third, this study focused on a single university and a 12-week intervention period; therefore, long-term effects on skill retention and exercise habits require further investigation.

5.6 Implications for Physical Education Reform The results provide practical insights for curriculum design in higher education. Integrating BOPPPS with traditional methods can combine the benefits of active learning and precise

technical training, leading to comprehensive student development. Universities are encouraged to adopt hybrid approaches that leverage technology (e.g., online pre-tests, video analysis) to improve feedback accuracy and personalize learning paths. This aligns with the national “Healthy China” strategy by promoting lifelong exercise habits and enhancing students’ physical literacy and cultural identity.

Recommendation

To optimize martial arts teaching and fully leverage the advantages of the BOPPPS teaching model, several practical strategies are proposed:

1. Strengthen Instructional Design and Classroom Flow Teachers should carefully design each phase of the BOPPPS process, particularly the Bridge-in and Summary stages, which frame and consolidate the learning experience. The introduction should creatively connect course content with real-life scenarios, Wushu culture, or multimedia demonstrations to capture students’ attention. The summary should guide students to reflect on key points and evaluate their own progress, creating a closed loop learning cycle that enhances retention and transfer of skills.

2. Adopt a Hybrid Teaching Model While the BOPPPS model is highly effective for promoting engagement and participatory learning, traditional demonstration–imitation drills remain crucial for achieving technical precision. A blended approach is recommended: teachers can use BOPPPS for pre-class preparation, participatory learning, and post-class reflection, while allocating some in-class time to repetitive technical drilling for movement standardization. This ensures both cognitive understanding and technical refinement.

3. Diversify Assessment and Feedback Mechanisms A comprehensive, multi-dimensional evaluation system should be established to measure not only final skill performance but also process-oriented behaviors such as participation,

teamwork, and self-regulation. Formative assessments, peer review, and self-assessment should be incorporated to encourage active engagement and personal responsibility. Real-time feedback tools and rubrics can guide students in identifying specific areas for improvement and foster continuous progress.

4. Integrate Educational Technology Digital platforms and analytics can significantly enhance the precision and efficiency of martial arts instruction. Teachers should use online pre-tests, flipped classroom tools, and video analysis to diagnose students' baseline skills before class, design tiered group activities, and provide targeted feedback afterward. The integration of AI-assisted motion capture or VR simulation could further improve students' technical accuracy while ensuring safety in high-risk movements.

5. Invest in Teacher Training and Professional Development Effective implementation of the BOPPPS model requires teachers to master lesson planning, time management, and facilitation skills. Universities should offer professional development workshops, micro-teaching sessions, and peer observation opportunities to help educators refine their teaching strategies. Building a shared digital repository of martial arts lesson plans and case studies can also save preparation time and encourage best practice sharing.

6. Promote Extracurricular Engagement and Cultural Continuity To sustain the educational impact beyond the classroom, universities should organize martial arts clubs, competitions, and cultural exchange events. These activities not only strengthen students' physical literacy but also deepen their understanding of Wushu philosophy and ethics, helping to preserve its cultural significance. Long-term monitoring of students' exercise habits can further evaluate whether martial arts training fosters lifelong fitness behaviors.

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